ORGANIZATIONAL IMMUNITY AND ITS EFFECT ON STRATEGIC TECHNOLOGICAL CHANGE OPTIONS A FIELD STUDY AT JORDANIAN INDUSTRIAL COMPANIES LISTED IN AMMAN STOCK EXCHANGE

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ABSTACT

This research investigates the effect of Organizational Immunity (OI) on the Strategic Technological Change Options (STCO) through applying them to 47 Jordanian industrial companies listed on the Amman Stock Exchange. Analysis and interpretation of the results demonstrated the acceptance of the research model and the derived hypotheses, and that there are stable successive relationships between OI and STCO, so the more OI moves from Weak to Medium to Strong, the more the organization has managed to transform in STCO from Derivatives to Platform to Breakthrough and then to R&D. There are relationships and impacts allowing that OI can be adopted to explain the nature of change in STCO. Finally, evidences indicated that the level of immunity of the researched companies was medium, which led to tendency and focus on Derivatives and Platform due to their low cost and reluctance of the Breakthrough and R&D options as they require superior people and sophisticated technology. The study, based on the results, recommended increasing investment in Breakthrough and R&D options, and enhancing the OI to become a permanent competitive merit within companies, which is reflected in external capabilities and advantages in markets.

Keywords: Organizational Immunity (OI), Strategic Technological Change Options (STCO).

INTRODUCTION

OI is one of the key competencies in business organizations and effective management in building and defending competitive advantages. OI requires creating multiple capabilities related to potential technological options and as a start, the research investigates the economies of technological change based on OI strength from a strategic perspective as the focus is on multiple immunities as an approach to achieving sustainable OI, and this approach is considered as a modern and different viewpoint of the interpretation of the OI rules.

So how do organizations ensure that they invest OI effectively in expanding their technological options?

This research seeks to find the relationships between three OI elements (organizational learning, organizational memory, organizational DNA) that affect STCO (Derivatives, Platform, Breakthrough and R&D) from the viewpoint of a sample of people working in Jordanian industrial companies.

LITERATURE REVIEW

Organizational Immunity (OI)

This research uses the term OI metaphorically for biological immunity due to the similarities of characteristics and functions of both organizational and human entities (Huang, 2013).

OI is defined as the company's resilience represented by its ability to protect and defend itself, whether by preventing or overcoming vulnerabilities and threats, removing and avoiding them by preventing their growth or stopping their impact (Farncombe, 2014; Simmons, 2013). Models of OI vary based on researchers, intellectual mindset and practical goals. Perry (2014) specified the OI requirements as: leadership, integration, flexibility, participation, problem-solving culture, empathy, power distribution, and learning. Simmons (2013) sees it as residing in: monitoring and oversight committees, compliance with laws, risk management systems, incentives and rewards. Iit focuses on: the natural organizational immunity represented by the competitive position and organizational DNA, and the natural acquired immunity represented by immune cells, benchmarking and organizational memory. Huang (2013) indicated that it is based on: organizational learning and organizational memory and organizational knowledge, whereas Brown (1997) emphasized it is represented in organizational genes. DeGeus (1997) went back to its roots which are reflected in: the organizational structure, information flow, culture of power distribution, the right to make decisions, and systems of incentives and rewards.

As a result of the variation and difference of the above mentioned, our research has got to choose the OI dimensions that were repeated more than others due to the existence of a relative agreement on them, as follows:

- Organizational learning: It simulates the function of Thymus (T) cells in the human immune system which play a critical role in protecting human being from viruses, and organizational learning refers to the growing awareness of organizational problems and then their identification and treatment, which positively reflects on the organization's performance and outputs (Abdul-Majeed, 2016). Organizational learning consists of (individual learning, group learning, learning from others i.e. competing organizations, and self-learning i.e. within the organization) (Smith & Chris, 2013; Neilson et al., 2004; Argote & Miron-Spektor, 2011).
- Organizational Memory: It simulates the memory cells Bone Marrow (B) in the human immune system; these cells are able to remember what diseases a human being was infected and produce the appropriate antibodies to attack them. Organizational Memory includes evoking the knowledge of the previous archived knowledge of the organization through information intelligently stored and used in making current and future decisions and building sustainable competitive advantages (Park & Bunn, 2003). Organizational memory is similar to the human mind, as the organization recalls its past experiences in effectively dealing with current situations and planning for the future in light of prior knowledge (Watkins, 2007). Organizational memory consists of (intentional internal memory such as records, reports, expert systems, transformational core policies and processes, unintentional internal memory resulting from organizational culture, business environment, and organizational structure, and external memory including information about competitors, industry financial reports and government records (Hertzog et al., 1994).
- Organizational DNA: It simulates the human genetics Deoxyribonucleic Acid (DNA) which is necessary for life. ODN A reflects the company's own footprint that makes it different from others and enables it to accommodate strongly with competition. Organizational DNA is defined in the organization's key values, beliefs, culture and personality that shape its identity and determine its fate and are reflected in its performance and activities in such a way that limit or increase its capabilities and effectiveness (Ivanov, 2013; Persyn, 2014). The organizational DNA consists of the natural genetic footprint that belongs to a particular organization as natural defences such as the competitive

position and market share, and the acquired genetic fingerprint resulting from the organization getting rid of environmental dangers after which it has recovered, such as the immune cells resulting from the fact that some part of the organisation is exposed to an environmental impact and managed to recover and became immune to this danger; the Organizational Memory represented by previous treatments and the stored solutions; the Organizational Vaccine where outsourcing is used to deal with threats and risks; and Benchmarking when making use of alternatives that have proven successful with the toughest competitors (Hovivyan, 2006; Aguirre et al., 2005)

Strategic Technological Change Options (STCO)

Until recently, everything has been arranged and organized, and analysts have been able to easily classify companies and technology, and to inform markets of their products and services, and in a few years the situation changed, and industry and technology boundaries began to collapse and disappear (Evans & Annunziata, 2012) Apple threatens the auto industry; You Tube, Netflix, and Amazon have turned the TV industry upside down; Skype, Face book, Twitter, and Snapchat have changed people's perceptions about communication and associated cost. On the other hand, there are innovative companies that have become outdated, such as Kodak and Nokia, which have lost their way.

As a result, some traditional companies have begun to be in line with the reality that states the early stages of companies create a very serious challenge to them - for example, TAG Heuer, a Swiss watchmaker, has partnered with Google to strengthen their competitiveness On the other hand (Donzé, 2014*)*, many traditional companies believe that they cannot be overthrown by new companies except in the technology sector, but is there currently a sector that does not depend on technology? How many companies can also be classified as something else? Is Apple a technology company or a luxury watchmaker? Was Google a search engine or a driverless car manufacturer? (Jeannerat & Crevoisier, 2011).

As a result, biotechnology companies move beyond genetic choices, where competitive drugs (external core capabilities) produced for highly valued organizational industry are created and evaluated in response to the fading boundaries of technology and their success in doing so is determined by aligning their current immunity rules and their technological options.
Technological options are classified according to two dimensions: (change in product and change in the production process) into four levels (Jack & Samuel, 2011):

- Derivatives Option: This option focuses on bringing about slight improvement on the existing products such as reducing costs, improving packaging, and enhancing quality.
- Platform Option: It is a technology whose outputs are characterized as a new generation of existing products and it forms a platform for launching new products such as a new model for the same type of vehicle.
- Breakthrough Option: This results in sudden progress in knowledge or process technology such as the production of hybrid vehicles (gasoline + electricity).
- R&D Option: It provides the highest levels of creativity and imaginative innovation, whether in the creation of a new technology for production or new products or new services using scientific research and development such as mobile, Internet and so on (Paulo & Cauchick, 2006).

Based on the above, it is evident that the growing interest in OI is due to being related to variables that reflect efficiency and effectiveness of the company. Among these variables are the technological options as a situational variable, so our research comes to define the level of harmony and agreement between OI and STCO.

METHODOLOGY

Research Problem

The choice of OI and STCO in Jordanian industrial companies was not randomly researched, as the results of the survey study conducted by the researcher showed that there is a gap between the technological options adopted during the past five years and the desired and targeted technological options. When looking for the reasons behind this gap, it has become clear that there are OI-related determinants. The research problem lies in the OI weakness resulting from the existence of weaknesses in the capabilities of sample organizations, which leads us to adopting modest technological options. The following research questions were derived from the problem:

- Is there OI in the research organizations? What is the level of that OI? What are the dimensions and capabilities on which this immunity is built?
- What are the Strategic Technological Change Options (STCO) used in the research organizations?
- Does OI (and the associated variables) affect STCO (and the associated variables) positively and significantly?

Research Model

A hypothetical research model was designed based on the cause-effect relationship between OI and STCO (Figure 1). This model assumes that OI produces interactions that predict and contribute to determining the pattern of technological options as per the following sequence: The more the OI moves from weak to medium to strong, the more the organization is able to switch in its technological options from Derivatives to Platform to Breakthrough and to R&D.

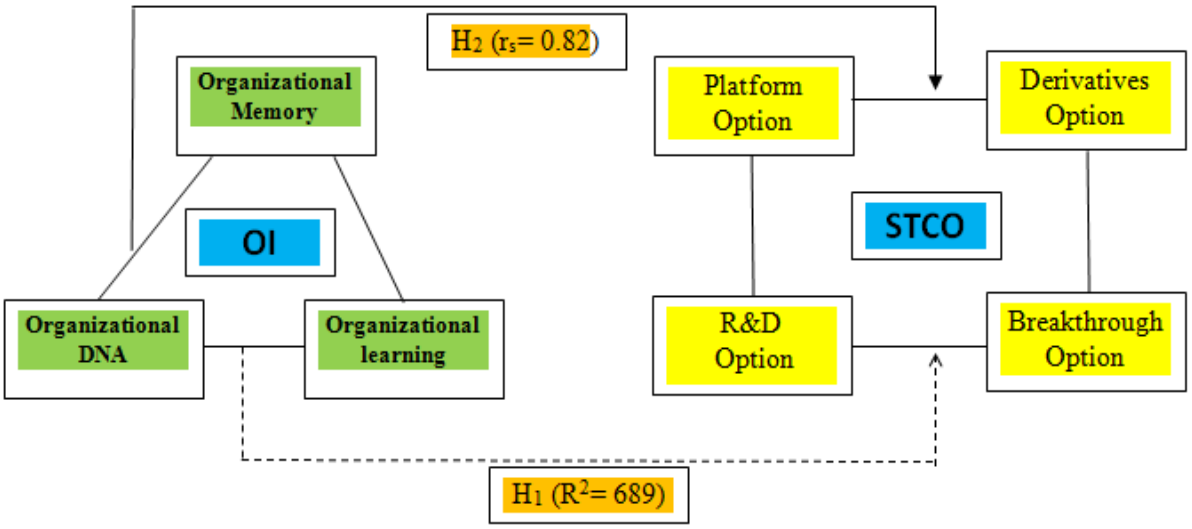

FIGURE 1
EFFECTS AND RELATIONSHIPS BETWEEN OI AND STCO

H_1 *A statistically significant relationship is expected between OI and STCO at (α = 0.05) in Jordanian industrial companies.*

H_2 *A statistically significant effect of OI is expected in STCO at (α = 0.05) in Jordanian industrial companies.*

Research Process

The research used the inferential method in defining its problem and forming its hypotheses, in two stages:

1. Descriptive research to establish theoretical concepts, review relevant studies, and field survey to collect data and information from the sample using a highly honest and reliable questionnaire.
2. Explanatory method to clarify the interconnections and effects between OI and STCO, and deduct causal relationships between them. Based on this, the research procedure included the following:

a. Data collection methods

The research combines the Secondary Data required to cover the theoretical framework and the Preliminary Data, using a questionnaire designed specifically to complete the research.

b. Research community and sample

The research community represents the (47) Jordanian industrial companies listed on the Amman Stock Exchange in 2019, and the inspection unit represented the staff working at those companies. Because it was not possible to use the comprehensive inventory method for time, effort, and cost considerations, only a sample was estimated according to the equation of Sekran (2006) as the sample size reached (406) individuals. The sample items were randomly chosen to give more opportunity to all employees to voluntarily participate in the research. The received questionnaires were 398, i.e. 98% of the total distributed questionnaires. 13 questionnaires were excluded after sorting and reviewing the incompleteness of the included data. Thus, the analysed questionnaires were 385 representing 94.8% of the total distributed questionnaires.

The characteristics of the research sample were: 385 individuals, 24% of them were managers, 47 companies were represented in the sample, 9 industries, 15% chemicals, 21% mining, 9% pharmaceutical and medical industries, 19% food and beverages, 4% tobacco and cigarettes, 3% electrical, 17% engineering and construction, 12% clothing, leather, and textiles, 87% of respondents are between the ages of 25-50 years, 47% of them have worked in their current jobs 1- 5 years, 33% have worked in their companies for more than 11 years.

C. Data Collection Tool

A questionnaire was designed to collect data from the sample consisting of 7 sub-variables that were defined and measured by 23 items included in the research questionnaire. The variables were distributed according to two dimensions: OI and STCO. Likert scale was used, whose measures range between 5 points meaning (Totally Agree), and 1point meaning (Totally Disagree) in order for respondents to express their views on the questionnaire items. Reliability of the questionnaire was confirmed by presenting it to specialists to show their point of view regarding the harmony and consistency of the content of the items with the goal to be achieved, and statistical reliability by applying to a trial sample by calculating Spearman Brown Reliability factors between the outcome of each item with the total scores of the questionnaire (23 questions * 5 scores). Correlation coefficients ranged between 0.378 - 0.624 which is a function at (=

0.05α) level. Likewise, a Content Validity test was performed by finding the square root of the stability coefficient and the results showed the validity of the questionnaire to measure what was prepared for it. The stability of the questionnaire (accuracy of measurement) was verified by conducting the Cronbach Alpha for the combined and individual research variables. The results demonstrated that the stability coefficients of the research variables increased and exceeded the required minimum limit. To ensure that the data is distributed normally, the factory Kolmogorov (K-s) test was performed where the results showed that the data is distributed naturally, and that the P-Value of all variables is greater (α = 0.05) Sekaran & Bougie (2016).

Hypotheses Test

H_1 test (Effect)

Results in Table 1 indicate the validity of the research hypothesis, and that there are statistically significant effects for OI and STCO in terms of R^2calculated for the model at (0.689). By testing this result using the calculated value of (F) at (4.13) and comparing it with the value of (F) scheduled at a degree of freedom (381.3) at a significant level (0.05) of (2.40), the model is statistically accepted as the calculated value of (F) is greater than the scheduled value of (F), and by comparing the calculated (t) values of OI variables with their tabular value at a degree of freedom (384) and at a significant level (0.05), the effects of OI variables are validated, and that the OI gained from organizational learning is used more in determining the pattern of technological options where it explained (58%) of the variance in technological options, the OI induced by organizational DNA and organizational memory strength (41% -51%) respectively, out of the variance of technological options.

Table 1
EFFECT OF OI ON STCO

Variables	Regression coefficients	Arithmetic mean	Standard deviation	R^2	t-Calculated
Organizational learning	B1	4.20	0.39	0.584	11.81
Organizational Memory	B2	2.31	0.69	0.412	9.13
Organizational DNA	B3	3.65	0.61	0.513	10.76
R^2 = 689; fixed limit B0 = 2.761; F- Calculated = 4.13					

To determine the relative effects of OI on STCO, the coefficient of elasticity of these variables was calculated using the following equation:

$$\frac{y_i}{x_i} = B\frac{\bar{x_\iota}}{\bar{y_\iota}}$$

Whereas: x_i= organizational learning, organizational memory, organizational DNA/$\bar{x}$= arithmetic mean of OI/ $\bar{y}$= arithmetic mean of STCO/B = value of regression coefficient of OI

It was clear that all OI variables (Table 2) affect STCO except for organizational memory.

Table 2
THE RELATIVE EFFECTS OF OI VARIABLES

	Variables	Coefficient of Elasticity
1.	Organizational learning	0.711
2.	Organizational Memory	0.276
3.	Organizational DNA	0.513

H_2 test (Correlation)

Table 3 shows that the STCO level was medium (3.58) and focused on the options of Derivatives and Breakthrough, which was reflected in the modesty of the overall performance indicators. The relative rise of the organizational learning process (4.2), this indicates a high ability to learn at the individual level (individual learning, group learning for teams) and at the organizational level (self-learning from its experiences, learning from others, i.e. competitors). As for organizational memory, it was weak (2.31), and this indicates the existence of problems in the process of collecting, analysing, evaluating, storing and sharing data and information, whether that information is from inside or outside the organization. Finally, the organizational DNA level was medium (3.65), which indicates clarity in values, beliefs and cultural identity in addition to incentive systems and power distribution.

At the micro level, the OI variables showed a variation in the number of its relationships and the level of their spirits, ranging from ($0.01 \leq P \leq 0.05$). The highest correlation coefficient was (0.79) with the Derivatives and the lowest correlation coefficient was (-0.42) between OI and R&D, and the number of significant relationships was (10) of the total relationships (12) were distributed as follows:

- Four significant relationships between organizational learning and STCO, all of which are direct and with significance (100%).
- Two significant relationships between organizational memory and STCO, the first is direct with the Platform option and the second is inverse with the R&D option and is of relative importance (50%).
- Four significant relationships between organizational DNA and STCO, all of which are direct, except for the relationship with the R&D option as it was inverse and of a significance (100%).

At the aggregate level, the correlation coefficient between OI and STCO was (0.82) with a significance level (0.01), and all relationships between OI and STCO variables were significant at (0.01); three were direct and one was inverse which explained (100%) of the total relationships which is a strong result for accepting H_2.

Table 3
ANALYSIS OF THE CORRELATIONS BETWEEN OI AND STCO

STCO / OI		Derivatives	Platform	Breakthrough	R&D	Total STCO	significant relationships	
							#	%
Organizational learning		0.82	0.76	0.39	0.24	0.79	4	100%
Organizational Memory		0.18	0.68	0.16	0.54 -	0.43	2	50%
Organizational DNA		O.65	0.73	0.23	0.37 -	0.69	4	100%
Total OI		0.79	0.78	0.48	0.42 -	0.82		
significant relationships	#	2	3	2	3			
	%	67	100	67	100			

DISCUSSION OF RESULTS

Many researchers have considered OI as a situational variable (Bhattaral, 2015; Gilley et al., 2009), so the variation in its strength leads to a change in the technological options. In order to prove the validity of this approach, the responses of respondents about research questions 1 and 2were analysed.

Question 1: Is there OI in the research organizations? What is the level of that OI? What are the dimensions and capabilities on which this immunity is built?

It is clear that each organization has some degree of OI varying from Very Strong to Very Weak. To identify the level of sample response to describe this immunity, the following is found:

- The research organizations enjoyed a high level of OI acquired through organizational learning, as it was clear that there was a tendency to individual and group learning and self-learning and learning from others.
- Weakness of OI acquired through organizational memory, whether that memory is internal, intended or unintended, or external.
- Moderation in OI acquired through organizational DNA in terms of organizational structure, culture of information exchange, rights of decision-making, and incentive systems.
- The % agreement on total organizational immunity ranged between (19%-81%-) compared to the % disagreement on the same items (8%-67%).

Table 4
ANALYSIS AND IDENTIFICATION OF THE IMPORTANCE OF OI VARIABLES

Organizational Immunity (OI)	Level of response				items		
	% agreement	% disagreement	severity of response	% reference weight	Arithmetic mean	Standard deviation	item value
Organizational learning	81	8	3.4	4.1	4.20	0.39	strong
Organizational Memory	19	67	0.9	2.2	2.31	0.69	weak
Organizational DNA	69	13	2.9	3.8	3.65	0.61	relatively strong
Total (OI)					3.87	0.71	relatively strong
Scale: 4.5-5 very strong; 4-4.49 strong; 3.5-3.99 relatively strong; 3-3.49 limited less than 3 weak							
severity of response=5(Number of answers Totallyagree)+4(Number of answers agree)÷Sample size				% reference weight=(Totally agree*5+ Agree*4+ Neutral*3+ Disagree*2+ Totally disagree*1) ÷ maximum degree			

Q2: What are the strategic technological change options (STCO) used in the research organizations?

Table 5 shows that 94% of the sample has a great interest in the Derivatives option (26% Agree - 68% totally Agree) and the Platform option (42% Agree - 44% totally Agree); this is supported by the value of the arithmetic means for these options, which ranged between (4.2 - 4.6) with standard deviations ranging between (0.39 - 0.41). It was found that 24% of the sample had a very low tendency to the R&D option (14% Totally Agree - 10% Agree) with an arithmetic means (2.43) and a standard deviation (0.64), while 13% of the mean sample took the Breakthrough option with an arithmetic means (3.1) and standard deviation (0.58).

Table 5
ANALYSIS AND IDENTIFICATION OF THE IMPORTANCE OF STCO

Standard deviation	Arithmetic mean	Importance of variants %					
		Totally agree	Agree	Neutral	Disagree	Totally disagree	
		5	4	3	2	1	STCO
O.39	4.6	68%	26%	3%	4%	2%	Derivatives
0.41	4.2	44%	42%	5%	5%	4%	Platform
0.58	3.1	28%	20%	13%	13%	26%	Breakthrough
0.64	2.4	14%	10%	18%	23%	35%	R&D
0.75	3.6						Total STCO

RESULTS AND RECOMMENATIONS

Results

The application of the search model led to important results indicating that OI produces interactions that contribute to the determination of STCO according to the following hierarchical relationship: The more the OI moves from Weak to Medium to Strong, the more the company can shift in its technological options from Derivatives to Platform to Breakthrough to R&D. It was clear that the level of immunity of the research companies was medium, which led them to tend more to focus on technological options (Derivatives - and Platform). There are severe significant effects between OI and STCO in terms of the value of R^2, which indicated that OI accounts for 69% of the total difference in STCO. OI variables were, respectively, in terms of severity of their effect (Organizational Learning, Organizational DNA, then Organizational Memory). Also, the value of the Spearman correlation coefficient demonstrated the existence of a strong direct relationship between OI and STCO at 100% of the relationships, and the OI variables were, respectively, in their strength as (Organizational Learning, Organizational DNA, and then Organizational Memory).

The results of statistical analysis also showed the following

- Average arithmetic means for OI, while its sub-variables varied, where the highest was Organizational Learning- strong/ then Organizational DNA- medium / then Organizational Memory - weak.
- Average arithmetic means for STCO, and its sub-variables were different where the highest was at the Derivatives option - strong / Platform option - strong / Breakthrough option - medium / R&D option - weak. Thus STCO is focused on the options of Derivatives and Platform for its low cost, which reflects a short-term vision, reluctance to options of Breakthrough and R&D for its high cost and its need for creative human capabilities and sophisticated technological requirements.

Recommendations

There is no doubt that the OI medium levels and the sample tendency towards the STCO focused on Derivatives and Platform rather than on Breakthrough and R&D are worrisome indicators, and makes the management of the research companies obligedtostrongly intervene to activate the OI and make it permanent competitive merit and shift to invest heavily in the options of Breakthrough and long-run R&D with the aim to reach the blue ocean strategy (sustainable advantage / excellence case) rather than the current red ocean strategy (volatile advantage / intense competition).

For achieving the above, the research companies should bring about a strategic fit between OI STCO –and this is subject to situational factors that, when changed, should shift to a desirable new pattern of new fit This requires the establishment of a specialized organizational unit concerned with diagnosing the OI level of the company and surveying it in terms of its effects and trends and how to strengthen it and develop various information systems to provide credible immediate information about the company's prevailing OI and STCO, and to conduct applied scientific researches on STCO taking into account the impact of OI systems as a key determinant of STCO.

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